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BRAINMINING EMOTIVE LATERAL SOLUTIONS¹

Theodore Scaltsas

Abstract: *BrainMining is a theory of creative thinking that shows how we should exploit the mind's spontaneous natural disposition to use old solutions to address new problems – our Anchoring Cognitive Bias. BrainMining develops a simple and straightforward method to transform recalcitrant problems into types of problems which we have solved before, and then apply an old type of solution to them. The transformation makes the thinking lateral by matching up disparate types of problem and solution. It emphasises the role of emotive judgements that the agent makes, when she discerns whether a change of the values or the emotions and feelings in a situation, which would expand the space of solutions available for the problem at hand, would be acceptable or appropriate in the situation. A lateral solution for an intractable problem is thus spontaneously brainmined from the agent's old solutions, to solve a transformed version of the intractable problem, possibly involving changes in the value system or the emotional profile of the situation, which the agent judges, emotively, will be acceptable, and even appropriate in the circumstances.*

Keywords: BrainMining; creative thinking; lateral thinking; emotive thinking; cognitive bias; anchoring bias; emotions; feelings; Kahneman; Tversky; Ariely.

Received accounts of creative thinking

Someone with no mathematical background asks me, what is mathematical thinking, and how does one do mathematics? I answer confidently that mathematical thinking is thinking analytically, and one does it by applying their analytical thinking to problems about quantities and shapes. Have I informed her about what mathematics is and have I instructed her how to do it? I have not, and yet, what I said is relevant and completely true. In fact, I could even claim that it is a universal feature of mathematical skills that it is an application of analytical thinking, thereby claiming to have centred on the very essence of this mental activity. Yet, where my explanation fails is in being too general a description of the phenomenon to be informative in a useful way. By contrast, showing and explaining the arithmetical operations, the axioms and the proofs of theorems of the mathematical disciplines puts one in a good position to understand what mathematics is and how to do it.

This is the problem we face with accounts of creative thinking. We give advice such as use your imagination; reframe; interrupt your reasoning; cooperate, and such, describing truly what happens when we think creatively, but not illuminating one as to what creative thinking is and how to do it. In fact, we do all these things on a daily basis, namely, using our imagination, reframing each time something does not go according to schedule or plan, become interrupted in endlessly many ways just as we are thinking about an issue, and cooperate with colleagues, friends and family; and yet, these activities do not generate creative thoughts. In what follows, I will examine representative accounts of creative thinking to show where they are wanting, and then offer a theory of creative thinking that aims to be more informative than hitherto accounts about the method of thinking creatively.

¹ Dedicated to the memory of Professor Anna Craft, collaborator in Co-Creativity.

One account I would like to discuss is the Honing Theory of Creativity developed by Gabora and Saab (2011:3506). There are different features of Gabora's account I would like to comment on. The Honing Theory describes creativity as an interaction between one's creative thought, e.g. solution to some problem, and her overall worldview. It is a question of fit of the novel with the existing, which inevitably results in the need to restructure one's worldview and organise it so as to accommodate the change. In so doing, Gabora says, one is engaging in a holistic conception of the creative act, not only seeing its impact in the problem's context, but also becoming aware of any consequences this change might have beyond the context in the world. This is a useful approach for the evaluation of creative acts, which is usually ignored in view of the utility and some times urgency for a local solution. But with respect to creative thinking, this is only telling us that it involves restructuring of thought. Since reframing is generally recognised as a feature of creativity, I do not see how this explanation of creativity offers us a new intuition into its nature. As I understand it, the Honing Theory of Creativity is primarily a prudential approach to the use of creativity.

A second feature of Gabora's account of creativity is her explanation of the role of memory neurons in creative thinking. It is widely known that creativity involves an interplay between convergent thinking and divergent thinking. The distinction was introduced by Paul Guilford (1967). Convergent thinking is used when there is a corpus of knowledge and a method by which we can extract the correct answer from it to a problem or a question. The uniqueness of the solution or answer is what characterises convergent thinking. By contrast, divergent thinking is an exploration of possibilities as solutions to a given challenge, which occur to one through possibly various methods of thinking. Gabora (2011:3509) uses this type of distinction, naming the two types of thinking analytic and associative, where analytic thinking is mainly rule-based, while associative thinking is an exploration of unusual correlations. She stresses that creative thinking involves the dynamic interplay between the two types of thinking in the search for a solution to a problem. She then reports findings in neuroscience according to which a certain type of neuron assembles in the brain when associative thinking takes place, which she sees as the seat of insights, but not when analytic thinking occurs (2011:3507). On its basis she suggests the following strategy for creativity: associative insight occurs when the corresponding neurons assemble in the brain during thinking about a problem. She then explains that associative type of connections between different contexts exploit features of situations which creative thinkers store in their memories. She brings all these together by correlating neuronal activity of that type with the interplay between analytic and associative thinking:

Knowing that creativity is associated with *both* conceptual fluidity on the one hand, and focus or control on the other, puts us in a good position to posit an underlying mechanism: the capacity to spontaneously and subconsciously adjust the spikiness of the activation function in response to the situation. Each successive instant of thought activates recruitment of more or fewer neuronal cliques ... (Gabora 2002:6-7)

My concern in reviewing Gabora's position here has been to point out that the creativity mechanism she describes is a correlation of brain neuron activity to creative thinking, rather than a mechanism of thinking that can be taught to students of creativity.ⁱ With respect to the latter, Gabora's account, as we saw, is the dynamic interplay of analytic and associative thinking, according to the situation at hand. As such, it is, again, a very generic description of creative thinking which cannot instruct students how to set about thinking creatively towards problem solving.ⁱⁱ

In a Lecture on creativity, Gabora points out that creative thinking involves the consideration of alternative possibilities (2011:3507). She uses the notion of quantum superposition to explain the concept of possibility. I wish to take issue with this explanation on two counts. The first is that the notion of possibility is by far the common

sense notion that we all have an understanding of and intuitions about. By contrast, we do not have a common sense conception of superposition, so as to resort to it to help us understand possibility and through it, creativity. The second concern is that possibility is not like superposition, unless with David Lewis (1969) one is a modal realist about possible worlds. Superposed states are not potentialities, but are considered to be real by physicists; Schrodinger's (1935) cat is both alive and dead! But even if it isn't really both, its state of affairs will not help us understand possibility.

I will examine a second account of creativity, which offers a model of creative thinking. This is Seelig's 'Innovation Engine', which she presents in her work *InGenius: A crash course on creativity* (2012:496-500). This model is characteristic of the way discussion develops in accounts of creative thinking. Seelig describes the various factors that are involved whenever one engages in problem solving, such as her attitude towards the situation she is facing; her knowledge in that domain; her imaginative flair; all of which interact with the factors in her environment, such as her habitat, the culture she is embedded in, and naturally her resources. The interplay of all these factors can generate creative ideas that solve the problem at hand. Similarly, Sean Kelly developed an account of creativity as the overlap of knowledge, of motivation and of creative thinking skills. What these and similar accounts of creativity, which develop descriptions along such lines, tell us is undeniable. But being undeniable does not make it explanatory of the process of creative thinking. It only describes the context in which problems arise and creative solutions occur, when they do.

In what follows, I will put my promissory claims and criticisms to the test, by undertaking to offer an explanation of the way creative thoughts are generated.

BrainMining

I will start the presentation of BrainMining with a terminological point. I understand the term 'creative' to mean something new, of an novel type, and desirable; whereas 'lateral' is all these, but also where the novel type is not just new but surprising, too; it has been called thinking 'out of the box'. A creative solution need not be lateral; thus, I can paint my bicycle a new colour, which is neither creative nor lateral; or paint it creatively with a colour that merges well with the environment; or I can get a neon-frame for my bicycle which would qualify as lateral. As I will use the terms, the difference between creative and lateral thinking is a matter of degree of novelty of type of solution, from untypical, all the way to surprising. The theory I develop here unfolds around two mental capacities of ours: *cognitive biases* we suffer from; and our *emotional intelligence*. The cognitive psychologist Daniel Kahneman, Nobel Prize in Behavioural Economics (2002), has shown in his work with Tversky (1974:1128) that we suffer from cognitive biases. I aim to show that this is in fact our mechanism for creative solutions, in that a particular cognitive bias, the anchoring bias, is a key step in the way creative solutions arise. The creativity method I propose shows how we can optimise the conditions under which this bias, which for our purposes we can call the 'creativity bias', kicks in to propose solutions. In most cases of intractable problems we face, our emotional intelligence also enters into the equation, to increase the space of possibilities of lateral solutions for the problem at hand.

What we are interested in, here, is to understand the thought mechanism of finding lateral solutions; to formulate the theory and the principles governing such a thought mechanism; and to then apply them to educational and training settings for training young people in finding creative solutions in business, managerial, and social problems. I will begin the presentation of my account with the role of cognitive biases in generating lateral solutions, and then come to an explanation of the role of emotions in thinking, generally, and in particular, the role of emotions in creating lateral, divergent thinking.

Generating the lateral from the familiar

'Beware of Greeks bearing Gifts!' The reason for this grim warning goes back all the way to Odysseus. He thought up the Trojan Horse scheme, which won the Greeks the Trojan war. His idea was a paradigm of *lateral creative thinking*, from conception to implementation.

An insight into understanding the pattern for how one reaches a creative solution such as Odysseus' is to be found, very surprisingly, in the evolutionary role of *sleep* for humans throughout the history of the species. Deirdre Barrett (2010), psychiatry professor at the Harvard Medical School, has shown that dreams have evolved to be particularly good at allowing us to work out puzzles. She says 'dreams and REM sleep have probably further evolved to be useful for really as many of the things that our thinking is useful for. It's just extra thinking time, so potentially any problem can get solved during it ... it's thinking time in the state that's very visual and *looser in associations*'. Not only is REM thinking time in our sleep looser in associations, but as we all know first-hand, it is also not limited by physical law or social convention in finding solutions.

Then how can dreams offer us solutions to the problems we face? I suggest that it is their *loose associations* and *freedom from rules* that give rise to 'out of the box' solutions in dreams, which, invariably, do not comply by the principles of rationality. What dreams achieve for us is that their looseness and freedom from rules result in *transforming* the problems we face into different problems. This generates a new version of the problem-case, and hence, new possibilities of ways out of the new problem. This is the gift *dreams* offer us: they *transform* our problem into a different problem, thereby opening up new solution spaces to explore. For instance, Kekulé dreamt of an image of a snake eating its own tail, which gave Kekulé the breakthrough of a cyclical structure for the benzene molecule, which had been an intractable problem for him and his colleagues (Rothermich, 1992).

We can better understand the way that we use dreams to solve our problems in light of the cognitive bias theory of Daniel Kahneman, for which he received the Nobel Prize in 2002. What Kahneman and Tversky (1974:1128-1130)ⁱⁱⁱ discovered and showed through their experiments is that we tend to view new problems in terms of old problems, and *apply the solutions of the old problems to the new problems*. We do this because the old solutions are the most 'cognitively available' to us. Kahneman and Tversky saw this as an *impediment* of our rational thinking and decision making, as it indeed it was in the contexts of their investigation. But my claim is that for creative thinking, old solutions are an *advantage* in problem solving, because they constitute a solution-depot that is available to the agent to consult, adapt, and reemploy. The history of innovation in social evolution, just as in biological evolution, is a step by step re-application of *old* solutions to generate *new* ones. An aquatic animal goes to land and gradually develops legs, generating a thoroughly novel species of life, through the employment of an old solution to a new problem. Even Einstein's Special Relativity theory, which was not simply an innovation in physics but a major paradigm shift, nevertheless, re-employed Henri Poincaré's previously formulated 'relativity principle' (Darrigol, 2005:9).

If, then, our minds are so wired as to inexorably tend to utilise old solutions to solve new problems, instead of treating this as an impediment of mismatching old solutions to unconnected problems, and instead of trying in vain to change our hard-wiring, we can:

Learn how to change the new problems to fit old solutions.

This is the key to the cognitive dimension of the creative lateral thinking theory developed here.

We shall view the agent's old solutions to problems as a 'treasure chest' of suggestions available to her in addressing new problem situations. Let us then address the conceptual *gap* between a current new problem one is facing and old solutions, which is what makes the new problem hard to solve, if not intractable. Bridging this conceptual gap is the challenge that our theory of creative thinking faces, in order to facilitate and expedite the possibility to utilise an old solution for the new problem. It is just such a bridge that dreams forge, when addressing our new problems, a bridge between a new puzzling situation and old solutions of the agent, e.g. the structure of the carbon atoms puzzling the scientist's mind, and visualising a snake wrapping itself into a circle. Yet, dreams can build such bridges with greater ease than we can, when deliberating over new problems, exactly because dreams solve the new problem in an 'altered world' which they generate, which transforms the problem, making it suitable to be solved by the old solution. Kekulé did not dream of carbon links; he dreamt of a snake wrapping itself into a circle. In retrospect, we see that he thought of the carbon linkage problem in the form of a snake, which then suggested the closed circular structure of the benzene molecule. This transformation of the problem is the key to the creative thinking methodology I follow here, namely, *transforming the problem at hand and using an old solution for this new version of it*. Odysseus could not solve the problem of how to overpower the Trojan fortifications that had resisted Greek attacks for a decade and sack Troy; instead, Odysseus transformed the resistance problem, turning it into a problem of how to deceive the Trojans – an area of expertise of his – and used an old type of solution in store – a pretence-gift – to solve the problem of sacking Troy. When Apple wanted to compete in the desktop and laptop market, whereas everyone else was producing faster and stronger computers to increase their sales, Apple decided to bring fashion into computer design. Making a product fashionable to sell more is not new; it is an old solution. Applying this to the dry and practical domain of computers *was* new, and so boosted Apple's sales.

The creative thinking methodology I am proposing consists in the *step by step transformation* of a new intractable problem, generating a *family of new versions* of the problem. The aim is to construct a transformed version of the problem which will trigger *brainmining* in the agent's own resources reaching old solutions. How do we do this; what is the step by step transformation process? Let us try to learn from our dreams how to do this? Dreams reverse the rules of reality, and notoriously, they do so arbitrarily. We cannot reverse the rules of reality arbitrarily, but what we *can* do is alter, within limits, the *type* of problem the new problem is and then look for a solution. The method by which we can change a new problem is *reversal* of the factors blocking a solution. Starting with the problem-case, the agent considers the factors which block normal solutions in the situation. For example, the bravery of the Trojans is a major blocking component of the problem Odysseus was trying to solve, as was the successful fortification of the city, etc. Having identified the factors, the agent proceeds to mentally *reverse* each one. This transforms the problem step by step, one factor at a time. Thus Odysseus *reversed* the rebuffing behaviour of the Trojans and considered circumstances in which the Trojans would not rebuff the Greeks. Each *reversal* of a factor of the problem *transforms* the problem into a different *type* of problem. The Greeks cannot overpower the Trojans, but they can deceive them. Transforming the problem changes the type of solution of the problem – this is the aim of the methodology, to change the intractable problem into a type of problem that requires different kinds of solutions. Each transformation is liable to trigger old solutions in the mind of the agent. The step by step transformation of the problem into different types of problem is bound to reach a type of problem that falls within the area of skilfulness of the agent, where old solutions abound. One of them might be feasible, and indeed unusual, lateral, as a type of solution for such a problem.

But there is a further dimension of problem solving that facilitates the possibility of creative lateral solutions. We shall examine this dimension of possibilities in what follows and how it combines with the brainmining dimension into one process of problem solving. Predictions the agent can make about emotional situations and reactions in the social context of the problem she is facing will reveal to her ways out of the problem which will enrich the space of solutions. When Odysseus transformed the problem of *overpowering* the Trojans on the Walls of Troy into a problem of *deceiving* them – an old solution for Odysseus – he still had to use his judgement as to which deception plan could work on the Trojans: he judged that the Trojans were proud of themselves as soldiers and predicted that the Trojan Horse would be accepted by the Trojans as a sign of the Greeks' respect for Trojan bravery. This was his call. Odysseus succeeded only because he predicted correctly the Trojans' *emotive* response to such a Greek offering. Similarly, Apple Inc. predicted correctly the buyers' emotive response to dressing computers in high fashion, rather than simply making them more powerful. As we shall see, emotive judgements are central to finding lateral solutions to most problems in the personal and social contexts.

Emotive judgements for lateral thinking

Values, emotions, and feelings *confine* what is acceptable behaviour in social and personal contexts. Yet values, emotions and feelings evolve and change. Their change alters the possibilities of solving problems at hand, by making the unacceptable acceptable, and vice versa. *Emotive judgements* judge exactly this – the possibility of changing the values, emotions, and feelings in the problematic context. Odysseus turned the attack-problem into a deception-problem, and judged emotively that the Trojans would be deceived by the Greek token of respect. This judgement led him to the solution.

Let us cumulatively outline the *steps* of Odysseus' emotive lateral thinking creativity, which led to the plan for the sack of Troy. After a ten year siege, the Greeks were giving up on taking over Troy. Odysseus tried to think creatively for a solution to the problem. He identified the factors blocking solutions, such as the Trojans being strong enough to rebuff all Greek attacks; there being no covert passageway to bypass the Trojans and enter the city; there being no way to blockade and starve the city to surrender; not being able to bribe the Trojans, etc. Odysseus proceeded to *reverse* each of these factors so as to generate a family of transformations of the problem. Some of these transformations did not look promising; but when he got to reversing that the Trojans rebuff the Greeks at the city walls, he reversed it, considering what conditions would change the Trojan behaviour; what if the Trojans did not resist the Greeks at the walls? Deceit popped up as a possibility, and from that point on, the problem was altered from a problem of attacking the soldiers to a problem of deceiving the soldiers, for which Odysseus had a host of old solutions from his cunning past. At that point, the choice of a solution depended on Odysseus' ability to judge and predict Trojan emotive reactions to possible deception schemes, which he did successfully. So, through systematic transformation of the problem by reversal of blocking factors, Odysseus converted the problem into one that triggered an old solution, which he explored guided by his emotive judgement to reach a possible solution to their impossible problem.

Creative lateral solutions require a mechanism of non-linear thinking which involves judgements about emotional states and feelings. Antonio Damasio (1994), a neuroscientist and philosopher, argued for the primacy of feelings and the dependence of concepts on feelings. He discovered in his experiments that people's decision making is effectively guided by their feelings rather than by rationality. Emotions seem to have always been the guide to decision making for actions. Damasio traces the primacy of emotion back to before organisms were formed – the era of macromolecules. Keith

Stenning used Damasio's insights in interpreting Wittgenstein's remarks on the meaning of words. Starting from Damasio's experimental findings, supplemented by a large volume of further experimental cognitive research that followed, Stenning (2002; 2010) developed a theory of *emotions* as implementations of rational choice theory and reasoning. The key conception in Stenning's theory (2002:217-219) is that *emotions ground abstract thinking*. *Conceptual classification* is guided by similarity in *emotional reactions* to situations. Stenning illustrates his theory with Wittgenstein's insight into the concept of 'game'. Wittgenstein showed that we cannot define the concept 'game', because there are no common characteristics shared between all the activities we call 'games'. Wittgenstein developed a semantic theory of the meaning of a term as a family of concepts which explain the linguistic behaviour of the term. Each concept in a family stands for a set of criteria determining a type of application of the term. And the family stands for the meaning of the term.

The key conception in Stenning's new theory is that the way the world *impacts on us emotionally* grounds the way we *comprehend* the world around us; emotions ground abstract thinking. Conceptual classification is guided by similarity in emotional reactions to situations. More generally, the way the world impacts on us emotionally grounds the way we comprehend the world around us. We classify things, activities, relations in our environment on the basis of the feelings generated in us from infancy in our interaction with our environment. It is emotions that operate as ground of *analogy*, of *similarity*, and of *comparison*. The concepts we use to classify and order our representations of what there is around us have affective foundations; on the basis of Damasio's results, such affective foundations predate, evolutionarily, the creation of language, and have guided our behaviour towards others, and in *cooperative* or *adversarial* situations in our environment.

If emotions are at the foundation of conceptual classification, is there here an insight about the mechanism of reasoning that can lead to an understanding of *non-linear thinking*? I claim that there is, namely, our emotional reactions are part of the content of reasoning, rather than external to our process of reasoning. Let me offer an illustrative example of this in one of the most celebrated instances of creative, lateral thinking in history:

Alexander the Great untying the Gordian Knot.

The challenge of the Gordian Knot was just to untie it – a puzzle of legendary difficulty. Alexander tried to untie it, and failing to do so, he drew his sword and cut the Knot. Did Alexander solve the Gordian Puzzle? In a sense, no, he did not, since he did not untie it. But the world has accepted his action as a creative resolution to the puzzle, and has celebrated Alexander for his creativity in the face of adversity. Why?

It is because Alexander's action *feels* like a solution to the puzzle – he defeated the puzzle by unravelling the Knot once and for all. It is this feeling of ours that led Alexander to take this bold step and put an end to the legend that was challenging his reputation. He found this original and creative solution, being directed by how he perceived this situation would affect *us emotionally*.

Alexander made a *second order* emotive judgement. In a first order judgement, an agent judges how a situation impacts on her. In a second order judgement, an agent judges how a situation impacts emotionally on another. In the present example, Alexander judged that we would classify what Alexander did as an 'untying of the Knot', because we would 'see' his action as the resolution of the puzzle. What Alexander did is not an 'untying'; but we readily see it as such, because, we feel that Alexander 'defeated' the puzzle, as expected – his action impacts on us as an untying of the Knot. What Alexander judged in his second order emotive judgement is that people felt such a high expectation of his being able to resolve a puzzle, which nobody else could resolve, that he felt that anything he did towards putting an end to the puzzle would be 'seen' by us as its resolution.

Utility of the theory

It would be useful to contrast the account of lateral thinking offered here to the standard accounts of creativity that are based on interrupting our thought process to generate divergent thinking. For example, De Bono's method aims for reframing by interrupting one's thinking with a casual concept (image, word); then it invites the agent to find a relation between that concept and the problem case, thereby *hopefully* generating a reframed version of the problem that may suggest a solution. I say 'hopefully', because rethinking the problem from the point of view of an accidental comparison need not lead to a new version of the problem or suggest a solution. There is no experimentally established causal link between interruption and reframing. Furthermore, the comparison is *highly labour intensive* for the agent. The agent exerts great effort in order to find something common between the casual concept and the problem case, requiring *sophisticated powers of abstraction* (e.g. use "tangerine" to interrupt thinking about inflation). Additionally, once this labour has been expended, there is *only one* new version of the problem that is generated. This may yield a suggestion for a solution, or not. One needs another casual word and further difficult abstraction work, for a second reframing to be generated, and so forth.

By contrast, the brainmining creative thinking methodology developed in this paper generates a new transformation of the problem in each reversal step, without being labour intensive, and without requiring sophisticated powers of abstraction. Furthermore, it has the advantage of enabling the agent to substitute the original problem with a new problem, which may be easier for the agent to resolve, given her expertise.

Brainmining also has consequences for the business world. In particular it recommends a particular type of sensitivity in hiring for positions where creative thinking is desirable. The theory shows that creatives exploit their *solution-bases*. An employer who wants to hire creatives should aim for candidates who have a rich database of solutions in their experience section. This need not be first-hand experience, but a conceptual repertory of solutions a various types which one may acquire from private, public life, literature, sports, and other types of activity. Well populated solution-bases, from a rich experiential background, would add to a candidate's promise for an ability to think creatively. Well-designed interviews can tap into such solution-bases in the candidates. If employees are, further, trained in brainmining, they will know how to reach and exploit these solutions when they face recalcitrant problems a work - a skill that their school, or company can teach them. The additional advantage, for lateral thinking, of aptitude in emotional intelligence is different, and much more difficult to evidence.

Teaching emotional intelligence

In brainmining, when the reversal of the problematic factors in a situation triggers old solutions in the agent, the range of solutions can be expanded if the agent can judge the emotional and value profile of the problematic situation and predict acceptability of a solution violating them or changing them. Learning how to discern the emotional profile of situations and how to manage it greatly increases the space of surprising, lateral solutions in dead-end problematic situations. The traditional educational attitude toward reason and emotion does not promote awareness of judgements about one's own or others' emotional dispositions when trying to find solutions to hard problems. The recognitions of the creative role of emotive judgements in lateral thinking and problem solving is bound to change this educational policy.

How can we teach students how to make second order emotive judgements? Making such a judgement requires that one is able to predict another's response to a new value (moral, social, personal value). Who can make such predictions? Who can teach others to make them? And who can teach *children* to make them? I will present here a survey of major theoretical theses one might attempt to use for this task, and pinpoint shortcomings, before arguing for an alternative theory.

One important predictive theory in the social domain is *Game Theory* (Dixit 1993). This is mainly a decision making theory which aims to find rational ways of cooperation and conflict resolution in one's pursuit of their interests. Game theory is developed in mathematical and logical models, and pertains to one's ability to decide best action even when one does not know how the others (adversaries) might act. The possible moves are prescribed, and only the others' decisions for actions are to be predicted within the same prescriptions. Creativity with respect to augmenting the possibility of solution does not enter Game Theory. It is therefore not appropriate for our present pursuit of lateral thinking through second order emotive judging.

A second widely used theory of social predictions is *Prospect Theory* (Wakker, 2010). It is a theory about behavioural economics, exploring how people choose and decide action in view of known probabilities of the outcome. It is a study of the biases people have towards phenomenal risk. It studies mainly the deeply rooted preferences of people which they cannot change, even if they are aware of them. Although it is useful to know about such deep rooted dispositions, one can always assume that they operate in all circumstances for everyone, since they are evolutionarily preferences that are very hard to overcome. Knowing about them is useful but would not give one an edge in a difficult to solve problem, because they are universal in human psychology.

But the study of behaviour in the economic domain, and of our biases, has given rise to a theory known as *Affective Forecasting* (Schwartz and Sommers, 2013). This is the study of predictions of one's future emotional states. It is in particular the study of our ability to forecast our own future states, and secondarily the future states of others, in a variety of future circumstances. I describe in what follows the Good Judgement Project and show that their method is empirical search for talented predictors, the *super-forecasters*, rather than a theory from which a teaching method could be derived. But their project delivers good methodological advice as to how to *enhance* forecasting outcomes.

Affective Forecasting raises the question of empathy, which led to the neuroscientific discovery and understanding of mirror neurons and their role in empathetic feelings. Empathy is the ability to understand or *feel* what another person is experiencing. It is not what we are looking for here, since we only need prediction of emotional reactions, for lateral thinking, not understanding or feeling another's predicted emotional reaction. But it is a first step. Empathy is related to one's *Emotional Intelligence*, which is one's ability to recognise their own emotions and others' affective states. But emotional intelligence is not a theory about prediction of emotional states, but only a study of what types of people have the capacity to make such emotive discernments and predictions. The theory does not study how to make predictions of possible responses to emotional or value changes in an environment. (For the relation of emotions to values, see also Jesse Prinz (2006) on emotions and moral judgment.)

We need to take stock. Predicting emotions of others on the occasion of changing values is very hard. For example, how would people respond to giving criminals the right to vote (which might be critical for winning an election)? But it is already very much in demand for business social problems, and it will become more so in the future. Even simpler affective forecasting is highly sought out professionally. So although we cannot master the topic and produce 'masters' of this kind of prediction, we ought to at least try. We saw above that empathy comes close to the ability to make emotive predictions. Can empathy be taught? A clue as to how can be found in the therapy of people who lack

emotional intelligence, autistic people. Autism is being treated with new therapies which are being devised. The key element in autistic therapy is teaching autistic people empathy skills.

Teaching students *empathy skills* would be a significant step towards enabling them to make second order emotive judgements about others' emotions. An important training method for such skills is games with *role playing*. Improving this skill would be a crucial step towards counterfactual second order emotive judgements about what others would feel, if they faced a new value. The latter would be the key to unlocking new possibilities for creatively solving impenetrable predicaments.

A hint for the teacher of creative thinking

Finding a creative lateral solution is, and is considered difficult. Surprisingly, thinking of a problem that requires a creative solution is also very difficult, because the problematic situation needs to be a dead-end one, though not impossible. But teachers have to produce such problems for the students, if they are to train them in creative thinking. The difficulty with describing an intractable problem is that the description should be *complete* enough to *block* all the 'obvious' solutions to the problem, though, without making it impossible to solve. *Describing* a situation that blocks all solutions one can entertain right-off is very difficult because the 'obvious' solutions are continuous with the creative ones. How does one describe the situation so as to block just the 'obvious' solutions in the description, but not the creative ones? How do we determine the cut-off point in the description?

This is the problem that any teacher faces, who tries to find dead-end circumstances, even in such courses as history, which on the face of it lends itself to providing human predicaments. The difficulty is that almost invariably, predicaments we find in history courses are *severely under-described*; they are presented as predicaments rather than being *shown* to be such through their descriptions. For example, in the case of the death of Lord Byron in Mesolongi, one could readily wonder whether it was avoidable. For instance, could he not see that death would be inevitable, if he stayed in a small city under siege? Would it not have made more sense to have escaped before the siege happened, and used his international prestige to solicit help for Mesolongi from the English, or other philhellenic nations or groups? Even if help could not be summoned in time, would he not have been more helpful to Mesolongi being on the outside, campaigning for them, rather than sacrificing his life for them with them? Etc. Such questions are appropriate for understanding whether Byron could have saved his life or served his purpose better.

But history books do *not* describe this or any other predicament with such completeness that makes it obvious that it is a dead-end situation. Therefore, although we *accept* the historical incidents as predicaments, we do not really *see*, but only accept, that other solutions were not viable. This does not recommend these situations for testing our creative lateral thinking capabilities. And if history courses are not suitable as creative thinking training grounds, what courses would be suitable?

In such situations as Byron's, we do not know that alternative solutions were not viable. But knowing what was not viable is essential for working out what would be possible in the circumstances. This is because *creative* solutions are just beyond the pale of the *viable*, but within the range of the *possible*. This borderline between the two, the viable and the possible in historical predicaments, is not given to the teachers or to the students of history books.

The problem specifically is that history courses *under-describe* historical predicaments, which therefore do not lend themselves as candidates of recalcitrant problems for creative solutions. In order to overcome this problem, so as to enable and direct teachers how to generate dead-end problem cases to train the students (on the basis of the material in

history, or geography courses, etc.) I make the following suggestion. As pointed out, the range from the viable to the creative is continuous. Let us exploit this, to help teachers set creative thinking problems for the students *gradually* from the course material.

The key for the methodology for designing hard problems to solve is the following. The teacher will give the students a case such as the Lord Byron predicament. The students will be asked to provide *alternative solutions* to the historical incidents in the predicament case. Inevitably, the students' alternatives will be partly based on historical fact, and partly on speculation (as in my examples above), since the historical fact is under described in their books. The teacher address the under-description problem by asking students, every time the students propose a plausible alternative solution to the historical predicament, to then *block* that option, and add the new ruling to the description of the historical predicament. Thus, in the example above, Lord Byron would *not* have had the option of galvanising English interest by escaping before the siege and campaigning in England; and he would *not* have had the option of campaigning for philhellenic interest for the battle in Mesolongi, etc. In that way, courses of action are increasingly blocked in the description of the predicament of Lord Byron, and the predicament gradually becomes more fully described, more difficult to resolve, *intractable*.^{iv}

Each subsequent attempt to find ways forward in Byron's situation will progressively cross the viable option barrier. It will thus require the students to brainmine for creatively solutions, employing the emotive lateral thinking methodology, for the increasingly harder predicament. Thus, the generation of an intractable problem for the students' lateral-thinking-practice will not be the task of the teacher; it will be only initiated by the teacher, to be built up by the students, step by step as they come up with solutions which they then block. The generation of the problem thereby becomes part of the creative thinking exercise for the students.

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Biographical information

Theodore Scaltsas^v holds the Chair of Ancient Philosophy at the University of Edinburgh. In recent years he has turned to the theory of creative thinking and the educational methods that can teach it at school, at university and in business. He is interested in understanding what problem solving is, and how concepts, emotions and values play their roles in it. He believes, with Aristotle, that analytic thinking is not purely conceptual, but emotive and evaluative deliberation as well. His theory of lateral thinking combines analysis, emotional intelligence, and valuative intelligence, towards problem solving.

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ⁱ Gabora (2010:2): 'Specifically, this article connects brain research to creativity by positing that the shift to an associative mode of thought conducive to creative insight is accomplished by recruiting *neurds*: neural cliques that respond to abstract or atypical aspects of a particular problem or situation. Because memory is distributed and content-addressable, this fosters the forging of creative connections to potentially relevant items previously encoded in these neurds.'

ⁱⁱ For instance, Gabora (2010) says: 'Thus it is proposed that creative thought involves neither randomness, nor search through a space of predefined alternatives, but emerges naturally through the recruitment of neurds. It is suggested this occurs when there is a need to resolve conceptual gaps in ones' internal model of the world, and resolution involves context-driven actualization of the potentiality afforded by its fine-grained associative structure'.

ⁱⁱⁱ Also, Tversky, A., and Kahneman, D. (1981).

^{iv} After creative solutions are proposed, it might be interesting and useful for the students to investigate whether their proposed alternatives in the classroom were historically viable in the circumstances in question, by carrying out further historical research on it.

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